Titan's Tropopause Temperatures from CIRS: Implications for Stratospheric Methane Cloud Formation

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Analysis of Cassini Composite Infrared Spectrometer (CIRS) far-IR spectra enable the construction of Titan's temperature profile in the altitude region containing the tropopause. Whereas the methane ν_4 band at 1306 cm^{-1} (7.7 μm) is the primary opacity source for deducing thermal structure between 100 km and 500 km, N_2–N_2 collision-induced absorption between 70 and 140 cm^{-1} (143 μm and 71 μm) is utilized to determine temperatures at Titan's tropopause. Additional opacity due to aerosol and nitrile ices must also be taken into account in this part of the far-IR spectral region. The spectral characteristics of these particulate opacities have been deduced from CIRS limb data at 58°S, 15°S, 15°N, and 85°N. Empirically, the spectral shapes of these opacities appear to be independent of both latitude and altitude below 300 km (Anderson and Samuelson, 2011, *Icarus* **212**, 762–778), justifying the extension of these spectral properties to all latitudes. We find that Titan's tropopause temperature is cooler than the HASI value of 70.5K by ~6K. This leads to the possibility that subsidence at high northern latitudes can cause methane condensation in the winter polar stratosphere. A search for methane clouds in this region is in progress.